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MATH 360
HW 9.3

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9.3 # 11

a.)

$\vec{a} = [2,1,0]$ $\vec{b} = [-3,2,0]$

$$\begin{array}{c|c|c} \hat{i} & \hat{j} & \hat{k} \\ \hline a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \end{array} = [\underbrace{a_2b_3 - a_3b_2}_{V_1}, \underbrace{a_3b_1 - a_1b_3}_{V_2}, \underbrace{a_1b_2 - a_2b_1}_{V_3}]$$ Determinant

$$= \hat{i}\begin{vmatrix} a_2 & a_3 \\ b_2 & b_3 \end{vmatrix} + \hat{j}\begin{vmatrix} a_3 & a_1 \\ b_3 & b_1 \end{vmatrix} + \hat{k}\begin{vmatrix} a_1 & a_2 \\ b_1 & b_2 \end{vmatrix}$$

$\vec{a} \times \vec{b}$: $a_1 = 2$ $b_1 = -3$

$a_2 = 1$ $b_2 = 2$

$a_3 = 0$ $b_3 = 0$

$\vec{a} \times \vec{b} = \vec{v}$: $\vec{v} = [v_1, v_2, v_3] = [0,0,7]$

$V_1 = 1(0) - 0(2) = 0$

$V_2 = 0(-3) - 2(0) = 0$

$V_3 = 2(2) - 1(-3) = 7$ $\Longleftrightarrow$
$\quad 4 + 3$

$$\boxed{\begin{array}{l} \vec{a} \times \vec{b} = [0,0,7] \\ \vec{a} \times \vec{b} = 0\hat{i} + 0\hat{j} + 7\hat{k} \end{array}}$$

b.)

$\vec{a} = [2,1,0]$ $\vec{b} = [-3,2,0]$

$$\begin{array}{c|c|c} \hat{i} & \hat{j} & \hat{k} \\ \hline a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \end{array} = [\underbrace{a_2b_3 - a_3b_2}_{V_1}, \underbrace{a_3b_1 - a_1b_3}_{V_2}, \underbrace{a_1b_2 - a_2b_1}_{V_3}]$$ Determinant

$$= \hat{i}\begin{vmatrix} a_2 & a_3 \\ b_2 & b_3 \end{vmatrix} + \hat{j}\begin{vmatrix} a_3 & a_1 \\ b_3 & b_1 \end{vmatrix} + \hat{k}\begin{vmatrix} a_1 & a_2 \\ b_1 & b_2 \end{vmatrix}$$

$\vec{b} \times \vec{a}$: $b_1 = -3$ $a_1 = 2$

$b_2 = 2$ $a_2 = 1$

$b_3 = 0$ $a_3 = 0$

$\vec{b} \times \vec{a} = \vec{v}$: $\vec{v} = [v_1, v_2, v_3] = [0,0,7]$

$v_1 = 2(0) - 1(0) = 0$

$V_2 = 0(2) - (-3)(0) = 0$

$V_3 = -3(1) - 2(2) = 7$ $\Longleftrightarrow$

$$\boxed{\begin{array}{l} \vec{b} \times \vec{a} = \langle 0,0,-7 \rangle \\ \vec{b} \times \vec{a} = 0\hat{i} + 0\hat{j} - 7\hat{k} \end{array}}$$

c.)

$\vec{a} = [2,1,0]$ $\vec{b} = [-3,2,0]$

$\vec{a} \cdot \vec{b} = a_1b_1 + a_2b_2 + a_3b_3$

$\vec{a} \cdot \vec{b} = 2(-3) + 1(2) + 0(0) = -6 + 2 + 0 = -4$

$$\boxed{\vec{a} \cdot \vec{b} = -4}$$

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Volume of parallel piped : $|\vec{a}\cdot(\vec{b}\times\vec{c})|$

$\vec{a} = 1\hat{\imath} + 1\hat{\jmath} + 0\hat{k}$
$\vec{b} = -2\hat{\imath} + 0\hat{\jmath} + 2\hat{k}$
$\vec{c} = -2\hat{\imath} + 0\hat{\jmath} - 3\hat{k}$

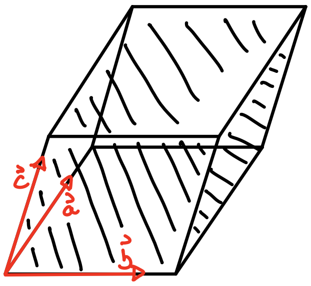
Determinant

$$\begin{array}{c|c|c} \hat{\imath} & \hat{\jmath} & \hat{k} \\ \hline a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \end{array} = [\underbrace{a_2b_3 - a_3b_2}_{v_1}, \underbrace{a_3b_1 - a_1b_3}_{v_2}, \underbrace{a_1b_2 - a_2b_1}_{v_3}]$$

$$= \hat{\imath}\begin{vmatrix} a_2 & a_3 \\ b_2 & b_3 \end{vmatrix} + \hat{\jmath}\begin{vmatrix} a_3 & a_1 \\ b_3 & b_1 \end{vmatrix} + \hat{k}\begin{vmatrix} a_1 & a_2 \\ b_1 & b_2 \end{vmatrix}$$

$$\vec{b}\times\vec{c} \quad \begin{vmatrix} \hat{\imath} & \hat{\jmath} & \hat{k} \\ -2 & 0 & 2 \\ -2 & 0 & -3 \end{vmatrix} = [0(-3) - 2(0), 2(-2) + 2(-3), -2(0) - 0(-2)]$$
$$[0, -10, 0]$$

$\vec{b}\times\vec{c} = [0, -10, 0]$
$\vec{a}\cdot(\vec{b}\times\vec{c}) = [1, 1, 0]\cdot[0, -10, 0] = 0(1) + 1(-10) + 0(0) = -10$
$|\vec{a}\cdot(\vec{b}\times\vec{c})| = 10$



$\boxed{V = |\vec{a}\cdot(\vec{b}\times\vec{c})| = 10}$